AODV PERFORMANCE OPTIMIZATION BASED MULTI-PATH ROUTING IN MANET

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ABSTACT
Ad hoc On-Demand Distance Vector (AODV), is a distance vector routing protocol that guarantees loop-free routes by using sequence numbers that indicate how new, or fresh, a route is and minimal length according to hop-count as a distance metric. However, AODV routing protocol itself does not consider the current load of nodes in the process of route discovery, so it may result in congestion in the path and localized network congestion. In This paper proposed mechanism combines Random Early Detection [RED] with AODV to detect incipient congestion and avoid congestion, so that network performance will improve. Goal of this paper is to achieve high throughput and controlled congestion in Mobile Ad hoc network.

KEYWORDS: *MANET (Mobile Ad hoc Network), AODV (Ad hoc On-Demand Distance Vector) Routing, RED (Random Early Detection), Congestion, Throughput*

I. INTRODUCTION

Mobile Ad hoc Network (MANET) [1] is self-organizing network of mobile devices which does not relay in any fixed infrastructure. MANET devices can be laptop, mobile phones and personal digital assistance (PDA's) is called mobile nodes. Mobile nodes in MANET can take part in the communication only if they are in the communication range of network, and nodes which are outside the transmission range of network cannot take part in communication. The dynamic nature of MANET with limited resources that can vary with time such as battery power, storage space and bandwidth makes QoS provisioning, a challenging problem. To prevent congestion, current internet use end-to-end congestion control [2], in this mechanism end host is responsible for detection of congestion. Packet loss is treated as congestion notification signal from routers.

One of recent research areas for the network is seeking some mechanism to avoid high packet loss rates. When a packet is dropped before it reaches to its destination, all the resources has been consumed in transit are inevitably wasted. In extreme cases, this situation can lead to congestion collapse in which high degrees of packet delay and loss occurs caused by routers discarding packets due to excessive congestion in the path from source to destination. Congestion control and queue management in the network has been one of the active areas of research from the past few years. Some enhancements have been made by some researchers to solve the problems of high packet loss rates. Loss rates are especially high during heavy network congestion, when a large number of connections compete for limited network bandwidth. Due to increase in network traffic, many congestion control mechanisms have been proposed, including the deployment of explicit congestion notification (ECN)[6], along with Random Early Detection (RED) techniques.

The rest of the paper is constructed as follows, section 2 discusses the AODV protocol and its route discovery and maintenance process; section 3 discusses the Random Early Detection process in details; section 4 discusses related works; section 5 discusses performance parameter for MANET section 6 Proposed Solution for AODV performance optimization in detail; section 7 concludes the paper and future work.

II. AODV

Ad hoc On-Demand Distance Vector (AODV) is a distance vector routing protocol, which is reactive. The reactive property of the routing protocol implies that it only requests a route when it needs, and does not require that the mobile nodes maintain routes to destinations that are not communicating. AODV guarantees loop-free routes by using route sequence numbers that indicate how new, or fresh, a route is. The AODV protocol is one of the on-demand routing protocols for ad-hoc networks which are currently developed by the IETF Mobile Ad-hoc Networks (MANET) working group. It follows the distance vector approach instead of source routing. In AODV, every node keeps a local routing table that contains the information of it neighbors it has to forward a data packet, so that it reaches the desired destination. In general, it is desirable to use routes which can have minimal length according to hop-count as a distance metric.

2.1 Route discovery

Whenever a source node desires a route to a destination node for which it does not already have a route, it broadcasts a route request (RREQ) message to all its neighbors. The neighbors update their information for the source and create reverse route entries for the source node in their routing table. A neighbour receiving a RREQ may send a route reply (RREP) if it is either the destination or if it has an unexpired route to the destination? If any of these two cases is satisfied, the neighbor unicast a RREP back to the source. Along the path back to the source, intermediate nodes that receive the RREP create forward route entries for the destination node in their routing tables. If none of the two cases mentioned is satisfied, the neighbour rebroadcasts (forwards) the RREQ.

2.2 Route maintenance

Nodes detect link status by periodically broadcasting HELLO packets. When a broken link in an active route is detected, firstly, the node lists those unreachable destination nodes in the unreachable area and any other node which uses those unreachable areas for the next hop in the local routing table, then a Route error (RERR) message is used to notify other nodes that the loss of that link has occurred. The RERR message indicates those destinations (possibly subnets) which are no longer reachable in the way of the broken link. If a node has received RERR packets and use of the notified invalid route, it will do a new route discovery process. When the destination node detects an invalid link which is connected with it will not take the initiative to generate RERR packets, but make its sequence number plus 1.

III. RANDOM EARLY DETECTION

Floyds et al proposed Random Early Detection (RED) [3] in 1993. The basic idea of this mechanism is that the router can detect incipient congestion by monitoring the average queue length. Once the congestion is detected, router selects the source terminal to notify the congestion. So the source terminal can reduce the data transmission rate before the queue overflow, and try to alleviate the network congestion. RED [4][5] algorithm consists of two steps: in the first step it calculate the average queue length, and in the second step it calculate the packet drop probability. Packet drop probability is used to decide whether to drop the packet or not, packet drop is treated as the signal of congestion.

A. **Calculation of the Average Queue Length**

RED calculates the average queue length (Avgq), by using the following formula:

$Avgq = (1-Wq) * Avgq + q * Wq$ …… (1)

Here, Wq represents the weighted value, and q represents the actual queue length in the sampling moments.

B. **Calculation of the Packets Drop Probability**

RED has two thresholds Minth and Maxth, which are related with queue length. When the packet reaches the router, RED calculates the average of the queue length Avgq immediately. Then it determines the packet drop probability based on Avgq , Minth and Maxth . When avgq is greater than Maxth, all packets are discarded, and the packet loss rate is 1. When Avgq is between Minth and Maxth, we have the following Packet Drop Probability (PDP) formula:

Pb = Maxp * (Avgq-Minth) / (Maxth-Minth)…. (2)
P = Pb / (1 – count* Pb) ……..(3)
Packet drop probability is used to decide whether to drop the packet or not, packet drop is treated as the signal of congestion.

IV. RELATED WORKS

Several solutions have been proposed in the literature for the Queue Management in Mobile Ad hoc Networks (MANET's). Some of them are as follows:
K. Dinesh Kumar et al propose a predictive queue management strategy named PAQMAN [7] that proactively manages the queue which requires negligible computational overhead and is lightweight. PAQMAN does not require any prior knowledge of the traffic model, this reduces Packet loss, Increases transmission efficiency. The performance has been compared with drop tail and those results show that PAQMAN reduces packet loss ratio while at the same time increasing transmission efficiency.
Torres Rob et al presented an innovative TCP [8] flow control method. This algorithm combines RED (Random Early Detection) with TCP window adjustment to improve the network performance. Taking the advantages of RED and window adjustment, the algorithm demonstrates superior stability and fast response with controlled packet dropping rate, and still fully utilizing the network resource. Author presented a novel analytical model based on the discrete Markov process in this research. Analysis and simulation show the effectiveness and robustness of the algorithm. The result of the algorithm shows that while fully utilizing the network resource this scheme achieves increased network stability with desired latency and packet dropping rate.
Guan-Yi Su et al present Random Early Detection Improved by Progressive Adjustment Method [9]. It regulates the packet dropping probability progressively by comparing the instantaneous queue size with the progressive maximum queue threshold parameters. The PRED's flexibility makes itself achieve higher transmission throughput and lower end-to-end average delay for various network topologies. RED algorithm computes the mean of the maximum threshold Maxth and the instantaneous queue size q to adjust the maximum threshold adaptively for various network conditions.
Kajal yadav, et al presented a mechanism Performance Improvement by Dynamic Queue Management in Mobile Ad hoc Network [10]. In which author suggested removing the shortcomings of RED, such as sensitivity to parameter configurations and traffic load. The average queue length of RED highly depends on the number of traffic flows and RED's parameters, especially the maximum packet dropping probability. Suggested mechanism decreased packet drop probability and improved throughput.
Li Yuanzhou, et al presented a mechanism Optimization Strategy for Mobile Ad Hoc Network Based on AODV Routing Protocol [11] in this paper performance is optimize on the basis of optimization of route discovery process, in this, the intermediate nodes handle the received packets according to their load state, their load state can be determined by calculation of the average queue length in Random Early Detection [RED]. When nodes receives RREQ packet According to the method of RED, set a maximum and minimum threshold for judging the handle method of RREQ packet early. According to the different network environment, parameter values should be adjusted accordingly.

V. NETWORK PERFORMANCE PARAMETERS IN MANET

Network performance refers to the service quality of providers to the customer. Performance parameters are used to measure the quality of services of the network. These parameters are given below.

A. **Throughput:** It gives the fraction of the channel capacity used for useful transmission (Data packets correctly delivered to the destination) and is defined as the total number of packets received by the destination. It is in fact a measure of effectiveness of a routing protocol.
B. **Average end-to-end delay:** This includes all delays caused by route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times.

C. **Packet delivery fraction:** The ratio of the data packets delivered to the destinations to those generated by the traffic sources.

VI. PROPOSED SOLUTION

Congestion occurs in the situation when the demand for resources exceeding the available capacity. Congestion control mechanism control congestion either before congestion occur or after congestion actually occurred. Due to limited range of each mobile host's wireless transmissions, each device needs to work in collaboration for proper functioning of network. In AODV protocol route is established by broadcasting route request packet, the intermediate nodes handle the route request packets according to their load state, their load state can be determined by calculation of the average queue length in Random Early Detection [RED]. When nodes receives RREQ packet, it consider the node congestion status, if there is no congestion means there is sufficient network resources then nodes which receives the RREQ packet (if it is not destination) forward RREQ packet instantly without applying delay. If there is a situation of extreme congestion then, node discard the RREQ packet to avoid the congested route. If there is situation between both above condition then node delay RREQ packet by some delay according to the node congestion status which can follow or may not follow same route. The proposed mechanism will utilize progressive adjustment mechanism to remove the parameter sensitivity and not to apply unnecessarily delay, due to RED parameter setting and apply delay on RREQ packets on actual load on nodes.

VII. CONCLUSION AND FUTURE WORK

Proposed mechanism will improve the network throughput, by diverting the packets from congested route to non-congested route. Proposed mechanism will also improve Packet delivery ratio and packet loss rate due to diversion of route towards non-congested route. Routing load also will equally distributed in other possible route if exists. The results will show that AODV performance improvement mechanism will enhances data forwarding capability of nodes, while reducing the packet loss rate and routing load. AODV protocol is not perfect because of limit time, so in future work will focus on this shortcoming.

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